

CLAIMS

1. A magnetic random access memory comprising:
 - a free layer which has reversible free spontaneous magnetization;
 - a fixed layer which has fixed spontaneous magnetization; and
 - a spacer layer formed of non-magnetic material and interposed between said free layer and said fixed layer,

wherein said fixed layer does not substantially exert orange peel effect and magneto-static coupling effect in said free layer.
- 15 2. The magnetic random access memory according to claim 1, wherein said fixed layer comprises:
 - a first pinned layer which has another fixed spontaneous magnetization in which a direction of a magnetization is fixed into a second direction opposite to a first direction as a direction of said fixed spontaneous magnetization; and
 - a second pinned layer which is provided between said first pinned layer and said free layer and has said fixed spontaneous magnetization, and
- 20 25 said first pinned layer and said second pinned layer are formed such that said fixed layer does not substantially exert in said free layer due to

the orange peel effect and the magneto-static coupling effect.

3. The magnetic random access memory according
5 to claim 2, wherein a summation of a first magnetic
field applied to said free layer by said first pinned
layer due to the orange peel effect and a second
magnetic field applied to said free layer by said
second pinned layer due to the orange peel effect is
10 substantially zero.

4. The magnetic random access memory according
to claim 2, wherein said fixed layer further
comprises:

15 another spacer layer of non-magnetic material
interposed between said first pinned layer and said
second pinned layer, and
said another spacer layer has a film
thickness such that said fixed spontaneous
20 magnetization and said another fixed spontaneous
magnetization are anti-ferromagnetically coupled.

5. The magnetic random access memory according
to claim 2, wherein said fixed layer is provided to
25 extend in said first direction, and
a distance between ends of said fixed layer
and said free layer is large to an extent that a

magnetic field generated by magnetic poles produced in said ends does not interlink with a magnetic field of said free layer.

- 5 6. A magnetic random access memory comprising:
 - a free layer which has reversible free spontaneous magnetization;
 - a synthetic ferrimagnetic fixed layer; and
 - a spacer layer formed of non-magnetic material and interposed between said free layer and said synthetic ferrimagnetic fixed layer,
 - wherein said synthetic ferrimagnetic fixed layer comprises:
 - a first pinned layer which has a first fixed spontaneous magnetization fixed in a first direction; and
 - a second pinned layer which has a second fixed spontaneous magnetization fixed in a second direction which is opposite to said first direction,
 - 20 said first pinned layer comprises:
 - a first portion provided to extend said first direction; and
 - a second portion formed on said first portion such that said second portion is aligned in position with said second pinned layer in a direction perpendicular to a surface of a substrate on which said magnetic random access memory is formed,

said first pinned layer and said second pinned layer are formed such that said synthetic ferrimagnetic fixed layer does not substantially influence on said free layer due to orange peel 5 effect,

5 effect,

when said first fixed spontaneous magnetization is M_1 , said second fixed spontaneous magnetization is M_2 , and said second portion has a thickness of t_2 , said second portion is formed to have a thickness of $(M_2/M_1) * t_2$, and

said synthetic ferrimagnetic fixed layer is formed such that said synthetic ferrimagnetic fixed layer does not substantially give influence of the magneto-static coupling effect to said free layer.

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7. A magnetic random access memory comprising:

a free layer which has reversible free spontaneous magnetization;

20 a synthetic ferrimagnetic fixed layer; and
a spacer layer of non-magnetic material
interposed between said free layer and said synthetic
ferrimagnetic fixed layer,

wherein said synthetic ferrimagnetic fixed layer comprises:

25 a first pinned layer which has first fixed
spontaneous magnetization fixed in a first direction;
and

a second pinned layer provided between said free layer and said first pinned layer to have second fixed spontaneous magnetization fixed in a second direction which is opposite to said first direction,
5 and

a summation of a first magnetic field applied to said free layer by said first pinned layer due to orange peel effect and orange peel effect and a second magnetic field applied to said free layer by said
10 second pinned layer is substantially zero.

8. The magnetic random access memory according to 7, wherein said synthetic ferrimagnetic fixed layer comprises:

15 another spacer layer of non-magnetic material provided between said first pinned layer and said second pinned layer, and

20 said another spacer layer has a film thickness such that said first fixed spontaneous magnetization and said second fixed spontaneous magnetization are anti-ferromagnetically coupled.

9. A magnetic random access memory comprising:
25 a free layer which has reversible free spontaneous magnetization;

a fixed layer which has fixed spontaneous magnetization fixed in a first direction; and

a spacer layer formed of non-magnetic material interposed between said free layer and said fixed layer,

wherein said fixed layer is provided to
5 extend in said first direction, and

a distance between ends of said fixed layer and said free layer is long to an extent that a magnetic field generated by magnetic poles in the ends does not interlink with a magnetic field of said free
10 layer.

10. A magnetic random access memory comprising:

a free layer which has reversible free spontaneous magnetization;

15 a synthetic ferrimagnetic fixed layer; and

a spacer layer of non-magnetic material interposed between said free layer and said synthetic ferrimagnetic fixed layer,

wherein said synthetic ferrimagnetic fixed
20 layer comprises:

a first pinned layer which has first fixed spontaneous magnetization in said first direction; and

a second pinned layer provided between said free layer and said first pinned layer to have second

25 fixed spontaneous magnetization in said second direction which is opposite to said first direction,

said first pinned layer comprises:

a first portion provided to extend in said first direction and said second direction; and

 a second portion formed on said first portion such that said second portion is aligned in position

5 with said second pinned layer in a direction

perpendicular to a surface of a substrate on which said magnetic random access memory is formed, and

 when said first fixed spontaneous

magnetization is M_1 , said second fixed spontaneous

10 magnetization is M_2 and a thickness of said second pinned layer is t_2 , said second portion has a

thickness substantially equal to $(M_2/M_1) * t_2$.

11. A magnetic random access memory comprising:

15 a free layer which has a reversible free spontaneous magnetization;

 a synthetic ferrimagnetic fixed layer; and

 a spacer layer of non-magnetic material

interposed between said free layer and said synthetic

20 ferrimagnetic fixed layer,

 wherein said synthetic ferrimagnetic fixed layer comprises:

 a first pinned layer which has a first fixed spontaneous magnetization in a first direction; and

25 a second pinned layer provided between said spacer layer and said first pinned layer to have second fixed spontaneous magnetization in a second

direction which is opposite to said first direction,
and

 said first fixed spontaneous magnetization,
 said second fixed spontaneous magnetization, a film
5 thickness of said first pinned layer and a film
thickness of said second pinned layer are determined
such that a magnetic field applied to said free layer
by said synthetic ferrimagnetic fixed layer due to
orange peel effect and a magnetic field applied to
10 said free layer by said synthetic ferrimagnetic fixed
layer due to magneto-static coupling effect are 10
(Oe) or below.

12. A magnetic random access memory comprising:
15 a free layer which has a reversible free
spontaneous magnetization;
 a synthetic ferrimagnetic fixed layer; and
 a spacer layer of non-magnetic material
interposed between said free layer and said synthetic
20 ferrimagnetic fixed layer,
 wherein said synthetic ferrimagnetic fixed
layer comprises:
 a first pinned layer which has first fixed
spontaneous magnetization in a first direction; and
25 a second pinned layer provided between said
spacer layer and said first pinned layer to have
second fixed spontaneous magnetization in a second

direction which is opposite to said first direction,
and

5 said first fixed spontaneous magnetization M_1 ,
said second fixed spontaneous magnetization M_2 , a film
thickness t_1 of said first pinned layer and a film
thickness t_2 of said second pinned layer are
determined to satisfy the following equation:

$$\frac{M_1}{M_2} \cdot \frac{t_1}{t_2} > 1$$

10 13. The magnetic random access memory according
to claim 12, wherein said M_1 and said M_2 are
substantively equal to each other.

14. The magnetic random access memory according
15 to claim 12, wherein said first pinned layer and said
second pinned layer are formed of same material.

15. The magnetic random access memory according
to claim 12, wherein the following equation:

20 $M_1 > M_2$,
is satisfied.

16. A magnetic random access memory according to
any of claims 1 to 15, wherein

25 said spacer layer is formed of non-magnetic

and insulating material, and

a thickness of said spacer layer is thin to
an extent that a tunnel current flows in a thickness
direction.